

EXHIBIT B

Mechanics and Materials Practice

Exponent®

**Metallurgical Examination of
Soldered Pipe Joints**

Metallurgical Examination of Soldered Pipe Joints

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Executive Summary

Exponent analyzed two pipe joints recovered from the Marino carriage house fire that occurred on December 20, 2002. Both pipe joints were soldered at some point prior to the fire, but were found separated under the kitchen sink after the fire. The purpose of the analysis conducted by Exponent was to determine when these two soldered joints were separated.

Exponent analyzed the subject joints by optical microscopy and scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS). The following results have been obtained from the analyses performed on these joints:

1. Both joints were comprised of a copper tube soldered to a brass fitting.
2. The solder was a lead-free, tin-based alloy with a small amount of copper.
3. The brass fittings were composed of a “free-machining” or leaded-brass.
4. A thick deposit of solder was present on the copper tubes, whereas significantly less solder residue was found on the corresponding brass fittings.
5. Lead was detected in the solder deposit on the outer surface of the copper tubes and the inner surface of the brass fittings.
6. A ridge of solder on one of the copper tubes showed no evidence of melting.

Based upon the results from these analyses, and general observations of the joints, Exponent has formed the following opinions with regards to the separation of these joints:

1. At the time the fire began, all joints of the water piping were intact.
2. The heat from the fire was sufficient to melt the solder at the copper/brass interface, but not the copper/copper soldered joints.

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3. Pressure within water line provided the force necessary to separate joint between the copper tube and the brass valve when the solder melted.
4. The separation of the joint between the copper tube and the brass compression fitting followed. Either the weight of the brass valve/copper tube assembly or the movement of components during the fire could have provided sufficient force to separate this joint once the solder melted.

Details of the testing and results that these opinions are based on are contained in the following sections of this report. If additional information becomes available or additional analysis is performed, I reserve the right to revise these opinions.

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Introduction

On December 20, 2002, a fire damaged the carriage house owned by Mr. Marino in Dedham, Massachusetts. The kitchen was among the rooms in the carriage house that incurred damage from the fire. The support structure surrounding the kitchen sink was weakened by the fire damage and resulted in the collapse of the sink. Upon investigation of the kitchen area, the sink was removed and water piping under the sink was inspected. One segment of piping from the cold water supply line was found separated from the other piping. This segment consisted of a brass valve soldered to a section of copper tubing, and is shown in Figure 1. The original location and orientation of this segment under the sink is shown in Figure 2.

The separated female portion of the brass valve shown in Figure 1 was originally soldered to the vertical section of copper tubing shown in Figure 3, and the copper tube was soldered to the brass compression fitting shown in Figure 4. The brass compression fitting was threaded onto a plastic-lined, flexible, braided stainless steel hose. This braided hose can also be seen in Figure 4.

It is readily apparent that, in order for the segment of piping shown in Figure 1 to become completely decoupled from the cold water supply line, two soldered joints had to be separated. It is also apparent that two conditions must be met to separate a soldered joint. First, the joint must be heated to a temperature sufficient to melt the solder. Second, a force must be applied to the joint to parallel to the pipe axis such that the opposing joint sections are pulled away from each other while the solder is molten. In this investigation, Exponent analyzed the joint sections shown in Figure 1, Figure 3 and Figure 4 to determine the point in time when these two conditions were met, leading to the separation of these joints.

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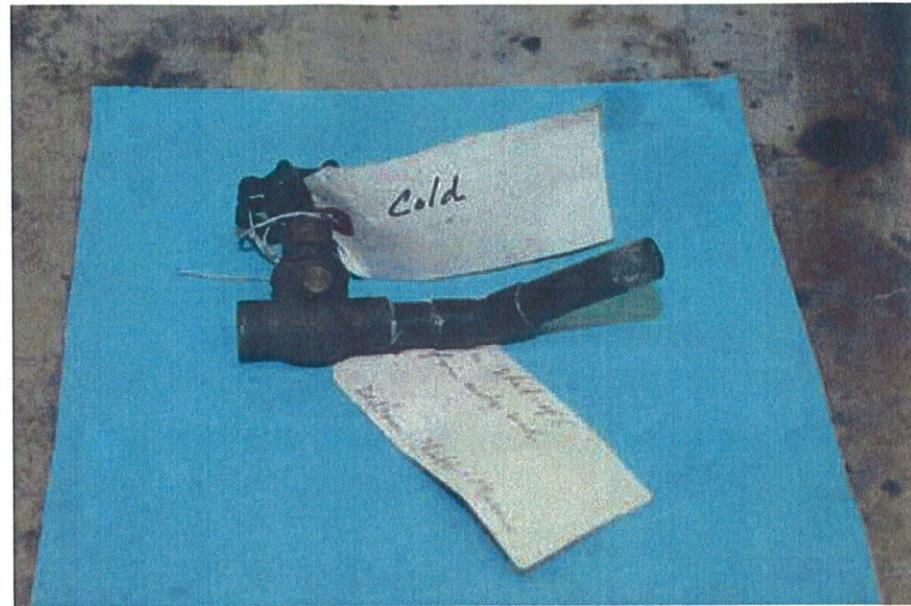


Figure 1. Photograph of the detached valve and connected copper tube. A photograph of the corresponding male fitting is shown in Figure 3 and the corresponding female fitting is shown in Figure 4.

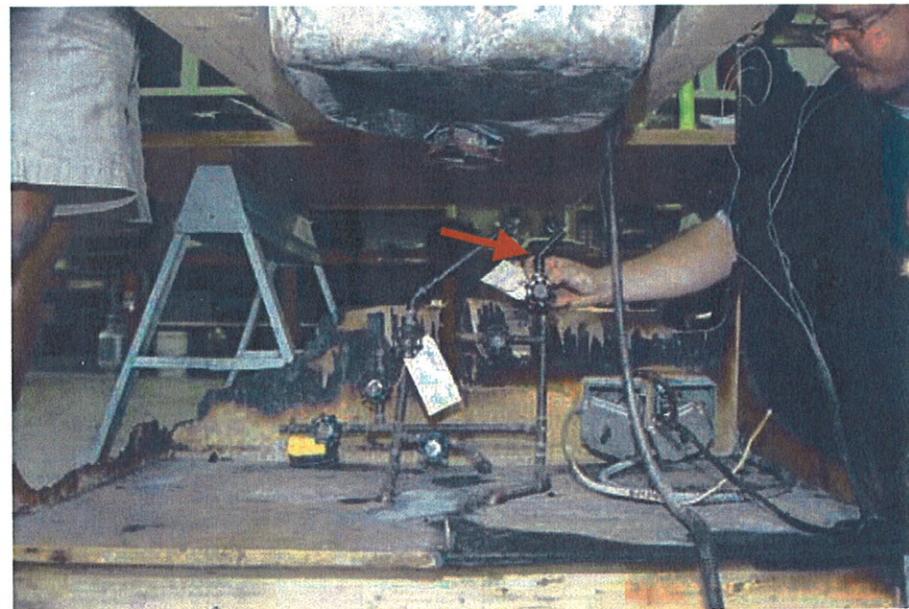


Figure 2. Photograph showing the area under the kitchen sink where the detached valve and connected copper tube would have been located prior to the fire. The red arrow denotes the separated brass valve/copper tube assembly shown in Figure 1.